

**REMARKS**

Currently pending claims 1-6 and 9-18, and 20 are for consideration by the Examiner.

Although claim 19 was canceled in the previous office action response, the Examiner considers claim 19 as pending. Accordingly, Applicants are not responding herein to the Examiner's rejection of claim 19.

The Examiner indicated that claims 7 and 8 are allowed. Applicants gratefully acknowledge the Examiner's indication of allowable subject matter.

The Examiner rejected claims 1, 2, 4, 9-13, 15 and 20 under 35 U.S.C. §103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403 B1 in view of Kanda et al., U.S. Patent 6,153,938.

The Examiner rejected claims 3, 5, 6, 14, 16 and 17 under 35 U.S.C. §103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403 B1 in view of Kanda et al., U.S. Patent 6,153,938 as applied to claims 1, 2 and 4 above, and further in view of Chung, U.S. Patent 6,399,178 B1.

The Examiner rejected claims 18 and 19 under 35 U.S.C. §103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403 B1 in view of Chung, U.S. Patent 6,399,178 B1.

Applicants respectfully traverse the §103 rejections with the following arguments.

**35 U.S.C. §103: Claims 12, 4, 9-13, 15, and 20**

The Examiner rejected claims 1-2, 4, 9-13, 15, and 20 under 35 U.S.C. §103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403B1 in view of Kanda et al., U.S. Patent 6,153,938.

Applicants respectfully contend that claim 1 is not unpatentable over Zhang et al. in view of Kanda, because Zhang in view of Kanda does not teach or suggest each and every feature of claim 1. For example, Zhang in view of Kanda does not teach or suggest "wherein a surface area of the first pad exceeds a surface area of the second pad." The Examiner admits that "Zhang fails to teach wherein a surface area of the first pad exceeds a surface area of the second pad." The Examiner alleges that "Kanda teaches wherein a surface area of the first pad exceeds a surface area of the second pad. See **FIG. 1B** of Kanda."

Applicants respectfully disagree with the Examiner's allegation that Kanda teaches that a surface area of the first pad exceeds a surface area of the second pad. The Examiner alleges that FIGS. 1C and 3 of Kanda show the first pad as bump 2 and the second pad as not numbered in FIG. 1C and as shown in FIG. 3. The Examiner seems to be alleging that the pointed nipple 40 in FIG. 3 corresponds to the second pad in claim 1 and is shown in FIG. 3 as having a smaller surface area than has the bump 2. In response, Applicants contend that the nipple 40 is not a pad distinct from the first pad of bump 2. Rather, the bump 2 and the nipple 40 constitute a single pad. See Kanda, col. 6, lines 6-13 which discloses: "Next, reference numerals 36 and 38 indicate bump forming stages where heating is discontinued **while the tool is moved away from the semiconductor IC 1, so as to form a pointed nipple 40.** Finally, a reference numeral 50 indicates a bump forming stage where another tool is pressed against the pointed nipple 40 and/or

heated, to flatten the pointed nipple 40 so as to form a minor portion of the bump" (emphasis added). Since the bump 2 and the nipple 40 collectively constitute a single pad rather than a first pad and a second pad, Applicants maintain that the bump 2 and the nipple 40 cannot be cited as teaching or suggesting "wherein a surface area of the first pad exceeds a surface area of the second pad."

Additionally, Applicants respectfully contend that it is not obvious to combine Kanda with Zhang.

As a first reason why it is not obvious to combine Kanda with Zhang, Applicants respectfully contend that having the surface area of the first pad exceed the surface area of the second pad is incompatible with Zhang who discloses in the very opposite: In FIG. 3, Zhang depicts the surface area of the first pad (between portion 171 and bump 181) is being smaller than the surface area of the second pad 191. Therefore, having the surface area of the first pad exceed the surface area of the second pad would destroy the teaching in FIG. 3 of Zhang.

As a second reason why it is not obvious to combine Kanda with Zhang, Applicants respectfully contend that having the surface area of the first pad exceed the surface area of the second pad 191 would offer no utility to Zhang. Zhang's invention is directed to connecting the substrates 120 and 190 such that the respective interconnects in the substrates 120 and 190 are correctly aligned with each other, and Zhang teaches how to accomplish said alignment in col. 5, lines 27-36. Applicants maintain that having the surface area of the first pad exceed the surface area of the second pad 191 would not improve said alignment process or provide any other benefit to Zhang, since Zhang teaches a highly successful method of connecting the substrates 120 and 190 with each other.

As a third reason why it is not obvious to combine Kanda with Zhang, Applicants respectfully contend that the Examiner has not presented a persuasive reason for combining Kanda with Zhang. The Examiner alleges: "In view of Kanda, it would have been obvious to one of ordinary skill in the art to incorporate the surface area of the first pad exceeding a surface area of the second pad in the Zhang semiconductor device because the semiconductor chip is flipped over so that the formed bumps are ready to be pressed against a substrate having electrodes (column 6, lines 15-18)." Applicants respectfully contend that the preceding reason given by the Examiner makes no sense, and the Examiner has not provided any analysis to show the relevance of the preceding statement to Zhang. Additionally, the Examiner has not provided any analysis to show the relevance of the preceding statement to the requirement in claim 1 of having the surface area of the first pad exceed the surface area of the second pad.

The Examiner further states: "the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the combined teachings disclose a method for coupling a semiconductor substrate." In response, Applicants maintain that the Examiner has not identified any teaching, suggestion, or motivation in either Zhang or Kanda for combining Kanda with Zhang. Furthermore, Applicants maintain that Zhang alone teaches how to successfully couple a semiconductor substrate to another substrate, and the Examiner has not identified anything taught or suggested by Kang that meaningfully adds to said teaching by Zhang.

Based on the preceding arguments, Applicants respectfully maintain that the Examiner has not established a *prima facie* case for obviousness in relation to claim 1 and the rejection of claim 1 is therefore improper. Accordingly, Applicants respectfully maintain that claim 1 is not unpatentable over Zhang et al. in view of Kanda et al., and that claim 1 is in condition for allowance. Since claims 2-6 depend from claim 1, Applicants contend that claims 2-6 are likewise in condition for allowance.

Applicants respectfully contend that claim 9 is not unpatentable over Zhang et al. in view of Kanda, because Zhang in view of Kanda does not teach or suggest each and every feature of claim 9. For example, Zhang in view of Kanda does not teach or suggest "wherein a surface area of the first pad exceeds a surface area of the second pad by a factor of at least about 1.2". Applicants' arguments that Zhang in view of Kanda does not teach or suggest the preceding feature of claim 9 and that the Examiner has not presented a *prima facie* case for combining Kanda with Zhang are essentially the same arguments as was presented *supra* in relation to claim 1.

In addition, the Examiner stated that he does not consider the preceding factor of "at least about 1.2" as having patentable significance. In response, Applicants point out that the ratio  $S_1/S_2$ , where  $S_1$  and  $S_2$  is the surface area of first pad and second pad, respectively, is a novel feature of the present invention relating to extending fatigue life of the interface between the solder member and the first pad. See Specification, page 5, lines 7-13 for a discussion of how  $S_1/S_2$  affects said fatigue life. See Specification, page 9, line 14 - page 8, line 9 for a discussion of test data demonstrating the effect on fatigue life of varying  $S_1/S_2$ . Accordingly, Applicants

maintain that claimed ranges of  $S_1/S_2$  is novel and not obvious. Based on the preceding arguments, Applicants respectfully maintain that claim 9 is not unpatentable over Zhang in view of Kanda, and that claim 9 is in condition for allowance.

Applicants respectfully contend that claim 10 is not unpatentable over Zhang et al. in view of Kanda, because Zhang in view of Kanda does not teach or suggest each and every feature of claim 10. For example, Zhang in view of Kanda does not teach or suggest "wherein a surface area of the first pad exceeds a surface area of the second pad by a factor between about 1.1 and about 1.3". Applicants' arguments that Zhang in view of Kanda does not teach or suggest the preceding feature of claim 10 and that the Examiner has not presented a *prima facie* case for combining Kanda with Zhang are essentially the same arguments as was presented *supra* in relation to claim 1.

In addition, the Examiner stated that he does not consider the preceding factor of "between about 1.1 and about 1.3" as having patentable significance. In response, Applicants point out that the ratio  $S_1/S_2$ , where  $S_1$  and  $S_2$  is the surface area of first pad and second pad, respectively, is a novel feature of the present invention relating to extending fatigue life of the interface between the solder member and the first pad. See Specification, page 5, lines 7-13 for a discussion of how  $S_1/S_2$  affects said fatigue life. See Specification, page 9, line 14 - page 8, line 9 for a discussion of test data demonstrating the effect on fatigue life of varying  $S_1/S_2$ .

Accordingly, Applicants maintain that claimed ranges of  $S_1/S_2$  is novel and not obvious. Based on the preceding arguments, Applicants respectfully maintain that claim 10 is not unpatentable over Zhang in view of Kanda, and that claim 10 is in condition for allowance.

Applicants respectfully contend that claim 11 is not unpatentable over Zhang in view of Kanda, because Zhang in view of Kanda does not teach or suggest each and every feature of claim 11. For example, Zhang in view of Kanda does not teach or suggest "wherein a surface area of the first pad exceeds a surface area of the second pad by a factor between about 1.3 and about 2.0". Applicants' arguments that Zhang in view of Kanda does not teach or suggest the preceding feature of claim 11 and that the Examiner has not presented a *prima facie* case for combining Kanda with Zhang are essentially the same arguments as was presented *supra* in relation to claim 1.

In addition, the Examiner stated that he does not consider the preceding factor of "between about 1.3 and about 2.0" as having patentable significance. In response, Applicants point out that the ratio  $S_1/S_2$ , where  $S_1$  and  $S_2$  is the surface area of first pad and second pad, respectively, is a novel feature of the present invention relating to extending fatigue life of the interface between the solder member and the first pad. See Specification, page 5, lines 7-13 for a discussion of how  $S_1/S_2$  affects said fatigue life. See Specification, page 9, line 14 - page 8, line 9 for a discussion of test data demonstrating the effect on fatigue life of varying  $S_1/S_2$ . Accordingly, Applicants maintain that claimed ranges of  $S_1/S_2$  is novel and not obvious. Based on the preceding arguments, Applicants respectfully maintain that claim 11 is not unpatentable over Zhang in view of Kanda, and that claim 11 is in condition for allowance.

Applicants respectfully contend that claim 12 is not unpatentable over Zhang in view of Kanda, because Zhang in view of Kanda does not teach or suggest each and every feature of claim 12. For example, Zhang in view of Kanda does not teach or suggest "wherein a

distance from a centerline of the solder member to a closest lateral edge of the semiconductor substrate is at least about 0.25 mm.” The Examiner has not provided any argument that Zhang in view of Kanda teaches or suggests the preceding feature of claim 12. In fact, the Examiner has not even alleged that Zhang in view of Kanda teaches or suggests the preceding feature of claim 12. Applicants point out that the distance from a centerline of the solder member to a closest lateral edge of the semiconductor substrate is a novel feature of the present invention relating to extending fatigue life of the interface between the solder member and the first pad. See Specification, page 8, line 10 - page 10, line 19 for a discussion of test data demonstrating the effect on fatigue life of varying the distance from a centerline of the solder member to a closest lateral edge of the semiconductor substrate. Accordingly, Applicants maintain that claimed ranges relating to said distance is novel and not obvious. Based on the preceding arguments, Applicants respectfully maintain that claim 12 is not unpatentable over Zhang in view of Kanda, and that claim 12 is in condition for allowance. Since claims 13-17 depend from claim 12, Applicants contend that claims 13-17 are likewise in condition for allowance.

As to claim 20, Applicants respectfully contend that the Examiner has not presented any argument in support of the rejection of claim 20. Thus, Applicants contend that the Examiner has not made a *prima facie* case for obviousness in relation to claim 20 and the rejection of claim 20 is therefore improper.



**35 U.S.C. §103(a): Claim 18**

The Examiner rejected claim 18 under 35 U.S.C. §103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403B1 in view of Chung, U.S. Patent 6,399,178B1.

Applicants respectfully contend that claim 18 is not unpatentable over Zhang in view of Chung, because Zhang in view of Chung does not teach or suggest each and every feature of claim 18. For example, Zhang in view of Chung, does not teach or suggest "wherein a distance from a centerline of the solder member to a closest lateral edge of the semiconductor substrate is at least about 0.25 mm". The Examiner has presented no argument supporting that Zhang in view of Chung teaches or suggests the preceding feature of claim 18. In fact, the Examiner admits that "Zhang fails to disclose the dimensions ...." Thus, Applicants contend that the Examiner has not made a *prima facie* case for obviousness in relation to claim 18 and the rejection of claim 18 is therefore improper.

Additionally, Zhang in view of Chung, does not teach or suggest "wherein the underfill material has an elastic modulus of at least about 1 gigapascal". The Examiner admits that "Zhang fails to disclose ... wherein the underfill material has an elastic modulus of at least about 1 gigapascal." The Examiner alleges that Chung discloses an underfill material with an elastic modulus of at least about 1\_ gigapascal. Although Chung discloses the elastic modulus of the underfill material in units of psi (i.e., 2,000,000 psi, column 18, line 61) it is equivalent to Applicants units. In view of Chung, it would have been obvious to one of ordinary skill in the art to incorporate the elastic modulus of Chung into the Zhang semiconductor device because the rigid adhesive underfill perform is aligned with the substrate (column 14, lines 48-53)."

Applicants note that column 14, lines 48-53 of Chung states: "Rigid adhesive underfill

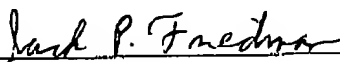
preform 110 is aligned with substrate 30 so that the pattern of solder columns 134 of preform 110 corresponds with the pattern of contact pads 132 of substrate 30." Thus, column 14, lines 48-53 of Chung merely describes how rigid adhesive underfill preform 110 is aligned with substrate 30, but does not provide a reason for the modulus of at least about 1 gigapascal as required by claim 18. Moreover, the preceding statement in Chung does not provide any motivation for a modulus of at least about 1 gigapascal in the underfill 310 in Zhang, and the Examiner has provided no analysis to support why a person of ordinary skill in the art would use an underfill having modulus of at least about 1 gigapascal in the underfill 310 in Zhang. In col. 6, lines 6-10, Zhang states: "after the assembly process, an underfill material 310 is dispensed or injected between substrates 110 and 190 to package or encapsulate the interconnect bumps and the first and second pluralities of interconnects. Material 310 protects the bumps from becoming over stressed during subsequent temperature cycles." Applicants contend that there is no reason, based on the preceding statement in Zhang, why a person of ordinary skill in the art would use an underfill having modulus of at least about 1 gigapascal in the underfill 310 in Zhang. Thus, the combination of Zhang and Chung is not obvious.

Based on the preceding arguments, Applicants respectfully maintain that claim 18 is not unpatentable over Zhang in view of Chung, and that claim 18 is in condition for allowance.

**CONCLUSION**

Based on the preceding arguments, Applicants respectfully believe that claims 1-6, 9-18, and 20 and the entire application meet the acceptance criteria for allowance, and therefore request favorable action. If the Examiner believes that anything further would be helpful to place the application in better condition for allowance, Applicants invite the Examiner to contact Applicants' representative at the telephone number listed below.

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